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ATTACHMENT TO A PATENT APPLICATION

DOCKET NO.: G48-1386-1

ENTITLED: APPARATUS AND METHOD FOR CUTTING SHEET-TYPE WORK MATERIAL USING A BLADE RECIPROCATED VIA A TUNED RESONATOR

INVENTOR(S): Darryl C. Stein

INCLUDING: Specification; Claims; Abstract; and four (4) sheets of Informal Drawings

APPARATUS AND METHOD FOR CUTTING SHEET-TYPE WORK MATERIAL USING A BLADE RECIPROCATED VIA A TUNED RESONATOR

CROSS REFERENCE TO RELATED APPLICATION

[0001] This patent application claims priority to the Provisional Application, which was filed on July 26, 2002, as Application Serial No. 60/399,094, the disclosure of which is incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present invention is generally related to cutting sheet type work material and is more specifically directed to cutting said material via a vibrating blade.

BACKGROUND OF THE INVENTION

[0003] Sheet type work material such as that used for making garments as well as leather and vinyl used for upholstery, both on furniture and in automobiles, is often cut by spreading the work material onto a flat support surface and running a reciprocating blade carried by a cutting head over the work material while the blade engages and cuts it. Generally, the cutting head is attached to a beam which can move along the cutting table while the cutting head moves along the beam in response to commands issued from a controller. These blades can reciprocate at rates of 20,000 cycles per minute and up. As such, complex mechanisms must be employed to drive the blade. In addition, these mechanisms must be able to move between a working position when the blade engages the work material and a non-working position when the blade is spaced away from the work material. In addition to the complexity of the mechanism, the high rate of reciprocation causes the cutter drives to be quite noisy. Moreover, it can be difficult to accurately control the blade when operating at these speeds.

[0004] Another difficulty that occurs with cutting machinery configured in the above-described manner is that the blades tend to wear rather quickly and require frequent changing.

[0005] Based on the foregoing, it is the general object of the present invention to improve upon or overcome the drawbacks of the prior art.

SUMMARY OF THE INVENTION

[0006] The present invention resides in one aspect in an apparatus for cutting sheet-type work material that includes a resonator assembly. The resonator assembly comprises in part, a beam made from a suitable magnetically conductive material. A pick up, also formed from a suitable magnetically conductive material, is coupled to the beam and is positioned adjacent to at least one magnet. Resonating means associated with at least one magnet causes the magnet to move past the pick up at a predetermined rate thereby establishing an alternating magnetic field that in turn results in vibration of the beam and the pick up. A blade mounted to the beam also vibrates, thereby causing a cutting edge defined by the blade to reciprocate at the vibrating amplitude. The amplitude of the vibration will depend upon the configuration of both the beam and the blade. As the magnet passes proximate to the pickup an air gap is defined therebetween, this air gap is set at a predetermined width so as to maximize the transfer of magnetic flux and thereby the level of vibration in the beam. During operation, as the vibrating blade engages the work material, the sharpened edge defined by the blade cuts it.

[0007] Preferably, the magnet is mounted to a magnet retainer, which in turn is coupled to a motor. As the motor rotates, so too does the magnet retainer thereby causing the magnet attached thereon to pass across a face defined by the pick up. While one magnet has been described, the present invention is not limited in this regard as a plurality of magnets can be mounted onto the magnetic retainer with each passing across the face of the pick up upon rotation of the motor. The motor responds to commands issued from a controller which in turn monitors the vibrational levels in the beam and blade and compensates

by excelerating or decelerating the motor dependent upon whether or not the work material has any significant damping effects on the blade during operation.

[0008] In an embodiment of the present invention, a return bar is also provided and is in magnetic communication with the beam. The magnet retainer is positioned between the pick up and the return bar. Any magnets mounted onto the magnet carrier will define generally opposing magnetic polls. These magnets are positioned such that when one of the polls is aligned with the pick up, the opposing poll is aligned with the return bar. Air gaps are defined between the magnet and each of the pick up and return bar so that when the magnet is aligned with the pick up a magnetic circuit is formed such that magnetic flux passes from the magnet into the pick up, travels down the beam into the return bar, and then back into the opposing poll of the magnet.

[0009] In another embodiment of the present invention, the above-described motor defines a drive shaft which extends through the return bar. The magnet retainer is mounted to the drive shaft for rotation therewith and includes at least one magnet attached thereto. As similarly described above, the magnet is positioned on the retainer so that opposing polls will align with the pick up and the return bar during operation.

[0010] In the preferred embodiment of the present invention, the resonating assembly described above is used with a cutter table. The cutter table includes a frame and a support surface mounted on the frame and adapted to carry at least one layer of work material. A carriage is coupled to the frame for movement relative thereto back and forth in a first coordinate direction in response to commands issued from the controller. A cutting head is coupled to the carriage and is also moveable back and forth there along in a second coordinate direction generally perpendicular to the first coordinate direction. The resonating assembly is coupled to the cutter head for movement between a working position wherein the blade engages the work material carried by the support surface and a non-working position wherein the blade is positioned away from

the work material. During operation, the controller causes the carriage and the cutter head, as well as the resonating assembly, to cooperate and cut the work material.

[0011] The present invention also resides in another aspect in a method for cutting sheet type work material using a tuned resonator. In the method, at least one layer of sheet type work material is provided on a suitable support surface. A blade resonating at a known frequency is brought into engagement with the work material and moved thereover in response to commands issued from a controller. When the blade is in engagement with the work material, the resonance thereof causes the blade to cut through the material as it is moved therealong. The resonance of the blade can change as it engages the work material and is drawn therealong. This is caused in part due to the damping effects of the work material. Accordingly, the controller monitors the resonance of the blade and makes adjustments to the frequency of resonance to compensate for any damping caused by engagement with the work material.

[0012] An advantage of the present invention is that the resonating assembly is minimally complex and thereby more economical to manufacture, maintain, and operate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. 1 is a partial schematic illustration of a cutting table incorporating the present invention.

[0014] FIG. 2 is a perspective view of an embodiment of a mechanism for causing a blade to reciprocate via tuned resonance.

[0015] FIG. 3 is a partial schematic view of another embodiment of the present invention.

[0016] FIG. 4 is a partial schematic view of another embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] As shown in FIG. 1, a cutting table generally designated by the reference number 10, includes a frame 12 and a sheet-type work material support surface 14 adapted to carry at least one layer of work material 16, such as, but not limited to leather or vinyl. A carriage 18 is coupled to the frame for movement back-and-forth in a first direction as indicated by the arrows labeled "X." A cutting head 20 is mounted on the carriage 18 and is movable back-and-forth therealong in a second direction as indicated by the arrows labeled "Y." Both the carriage 18 and the cutting head 20 move in response to commands issued from a controller 21. As will be explained in detail below, a reciprocation assembly generally designated by the reference number 30 is mounted to the cutting head 20 and is movable between a working position, wherein they engage the work material 16, and a non-working position wherein they are lifted off of the work material. During operation, the carriage and the cutting head, 18 and 20 respectively, move in response to commands issued from the controller 20 over the work material 16. The reciprocation assembly 30, also in response to commands issued from the controller 21 moves between the working and non-working positions generating desired lines of cut in the work material 16.

[0018] As shown in FIG. 2, the reciprocation assembly 30 includes a mounting bracket 32. A cantilevered rod 34 is attached to, and extends from a portion of the mounting bracket 32. A pickup 36, formed from a magnetically conductive material, such as, but not limited to mild steel is attached to the rod 34. A motor 38 is attached to the mounting bracket 32 and includes a drive shaft 40 extending through the mounting bracket. A magnet retainer 42 is mounted in the drive shaft 40 and includes a plurality of apertures 44 each adapted to retain a magnet 46 therein. Preferably, the apertures 44 and the magnets 46 are equally spaced from one another about the magnet retainer 42. A blade 48 is removably mounted at an end of the rod 34.

[0019] During operation, the motor 38 in response to commands issued from the controller 21, FIG. 1, causes the drive shaft 40 and thereby the magnet retainer 42

to rotate. As the magnets 46 mounted to the magnet retainer 42, pass over the pickup 36, the magnetic flux therebetween causes the pickup to be attracted toward the magnet retainer 42 thereby causing the rod to vibrate which in turn causes the blade 48 to vibrate. The vibrating blade 48 can them be employed to cut the work material 16, FIG. 1. Depending on the speed of the motor 38, a resonant frequency for the rod can be reached thereby increasing the vibratory amplitude of the blade 48. As the blade 28 engages the work material 16, damping will occur. Accordingly, the rate of rotation of the motor 38 must be adjusted via commands issued from the controller 21 to compensate for any damping effect the work material may have.

[0020] A second embodiment of the reciprocation assembly of the present invention, shown in FIG. 3, is generally designated by the reference numeral 130. The reciprocation assembly 130 is similar in many respects to the reciprocation assembly 30 described above, and therefore like reference numerals preceded by the number 1 are used to indicate like elements. The reciprocation assembly 130 differs from the reciprocation assembly 30 in that instead of being supported on a mounting bracket the motor is mounted on a return bar 132. The motor shaft extends through the return bar 132 and the magnet retainer 142 is coupled thereto. In the illustrated embodiment, the rod 134 engaged the leg 135 forming part of the return bar 132. An air gap 137 is defined between the pickup 136 and the magnet retainer 142.

[0021] With the reciprocation 130 assembly configured in the above-described manner, the flux density generated between a magnet 146 and the pickup 136 is maximized and follows a path indicated by the arrows labeled 150. Without the return bar 132, the magnetic flux would return to the magnet 146 via its outer edge. This return path restricts the magnetic coupling since magnetic coupling and therefore force is greatest when the air gaps in the magnetic circuit are minimized.

[0022] While preferred embodiments have been shown and described, various modifications and substitutions may be made without departing from the spirit and scope of the invention. Accordingly, it is to be understood that the present invention has been described by way of example, and not by limitation.